Space Weather Technical Forecast

Issued on Thursday, 25 May 2023 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further R1/R2 radio blackouts likely. Active fluence expected throughout. Slight chance of G1/Minor Storm intervals to start.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with two M-class flares, the strongest of these a M1.8 flare from AR3311, peaking at 24/1721UTC. There are currently six sunspot regions on the visible disc. AR3311 in the north center disk remains the largest and most complex region on the disc, with a delta spot persisting within the active intermediate area. AR3310 maintains a large leader spot with much smaller trailing spots continuing to slowly emerge across both polarities. AR3312 is currently faint and AR3313 is unchanged. AR3115 in the southeast continues to evolve rapidly, with multiple small but distinctive umbra and penumbra emerging. No Earth directed CMEs observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar winds observed at L1 have averaged between 500-600km/s through the period, on a generally steady trend. Density was around or just below average. Total magnetic field strength was weak throughout, with the important north-south component varying weakly. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has remained at background levels throughout. High energy electron flux (greater than 2MeV), as measured at GOES16, reached High levels for much of the period, with a maximum of 2700 pfu at 24/1605UTC. The 24-hour integrated fluence rose above Active levels from 24/1800UTC on a rising trend, with 1.16e8 integrated pfu recorded at 25/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Moderate, with isolated to occasional M-class flares likely and a slight chance of X-class flares. These most likely from the complex AR3311 or the quickly developing AR3315.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected, although a weak CME may give some glancing influence on Days 2 or 3 (26 or 27 May). Solar winds expected to remain at elevated levels around 500-600km/s during Day 1 (25 May) due to the continued influence of the high speed stream from large coronal hole CH06/- in the southwest quadrant. Wind speeds are forecast to decline steadily from Day 2 (26 May) onwards towards background levels due to the waning influence of the high speed stream, although any decline may be temporarily inhibited by the possible CME glance. Geomagnetic activity is forecast to be remain generally Unsettled with Active intervals possible during Days 1 and 2 (25/26 May), due to the continued high speed stream influence, and there remains a slight chance of G1/Minor Storms in any periods of negative Bz. Generally Quiet to Unsettled levels expected Days 3 and 4 as conditions likely trend towards background.

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Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, but there is a slight chance of reaching the S1/Minor Storm threshold should any larger flares occur. High energy electron flux (greater than 2MeV) is expected to continue to reach High levels at the diurnal peaks, with peaks likely rising through the period. The associated electron fluence is also likely to follow a rising trend, with Active (1e8 integrated pfu) conditions now expected through the period.

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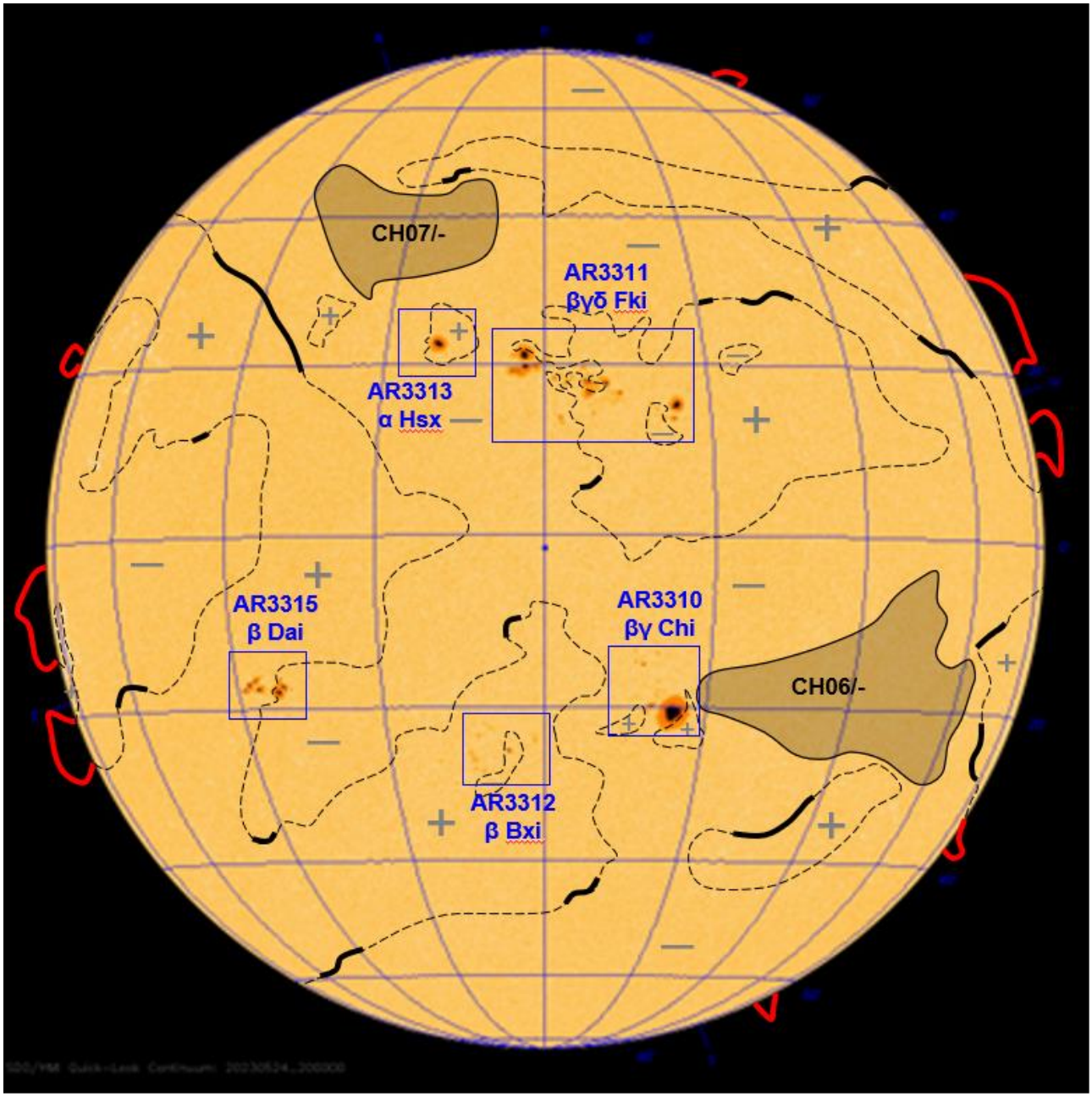
Figure 1. Solar Analysis Valid 24/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
There is a very slight chance of a CME which left the Sun on 22 May glancing Earth on Days 2 or 3 (26 or 27 May), although significant interaction is not expected. No further Earth-directed CMEs have been observed in available imagery.

Solar winds currently at elevated levels around 500-600km/s due to the influence of the high speed stream from large coronal hole CH06/- in the southwest quadrant and expected to remain so through Day 1 (25 May). Wind speeds are then forecast to decline steadily by Day 2 (26 May) onwards towards background levels due to the waning influence of the high speed stream, although any decline may be temporarily inhibited by the possible CME glance.

Geomagnetic activity is forecast to be remain generally Unsettled with Active intervals possible during Days 1 and 2 (25/26 May) due to the continued high speed stream influence, and there remains a slight chance of G1/Minor Storms in any periods of negative Bz. Generally Quiet to Unsettled levels expected Days 3 and 4 as conditions likely trend towards background.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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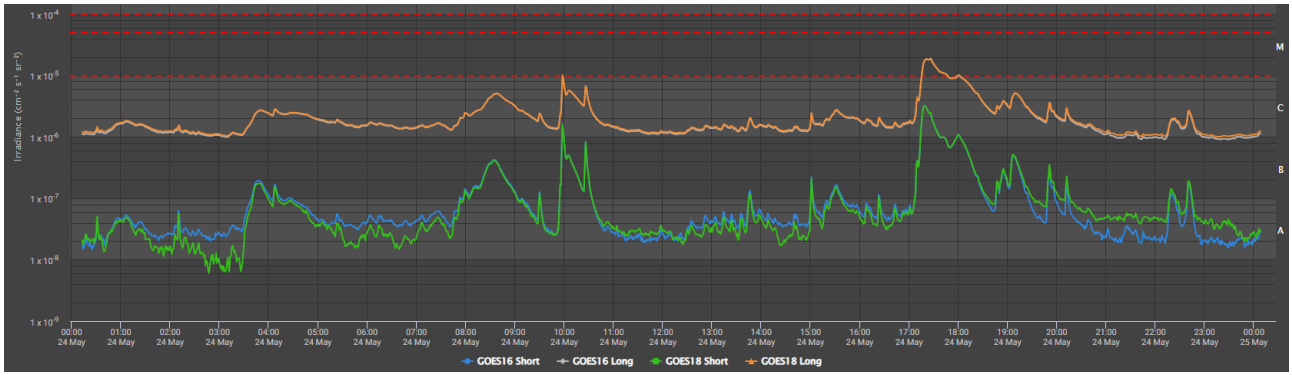
Radio Blackouts - X-Ray Flares:
Of the currently five sunspot regions on the visible disc AR3311 in the north center disk remains the largest and most complex region, with a small delta persisting within the active intermediate area. This region presents the bulk of the current flare risk as the source of multiple M-class flares in recent days. AR3310 now in the southwest maintains a large leader spot with much smaller trailing spots continuing to slowly emerge across both polarities. AR3115 in the southeast emerged in the last 24 hours and continues to evolve, with multiple small but distinctive umbra and penumbra emerging, representing an increasing flare risk. The remaining regions are simple or stable. A further active region appears to be rotating onto the southeast limb currently based on analysis of STEREO-A EUVI and far side seismic data.

Solar activity is expected to remain Moderate, with isolated to occasional M-class flares likely and a slight chance of X-class flares. These most likely from the complex AR3311 or the quickly developing AR3315.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	60	60	60	60
Very Active	**R3 to R5 X Class**	No	10	10	10	10

Figure 2: Latest 24hr GOES18 X-Ray flux



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at background levels and is currently expected to remain so throughout the period.

There is the risk of enhancement should any larger flares occur however, most likely from AR3311 or perhaps AR3315 as they rotate westward through the period, but also from regions that have recently rotated beyond the western horizon. As such a slight chance of reaching the S1/Minor Storm threshold is maintained throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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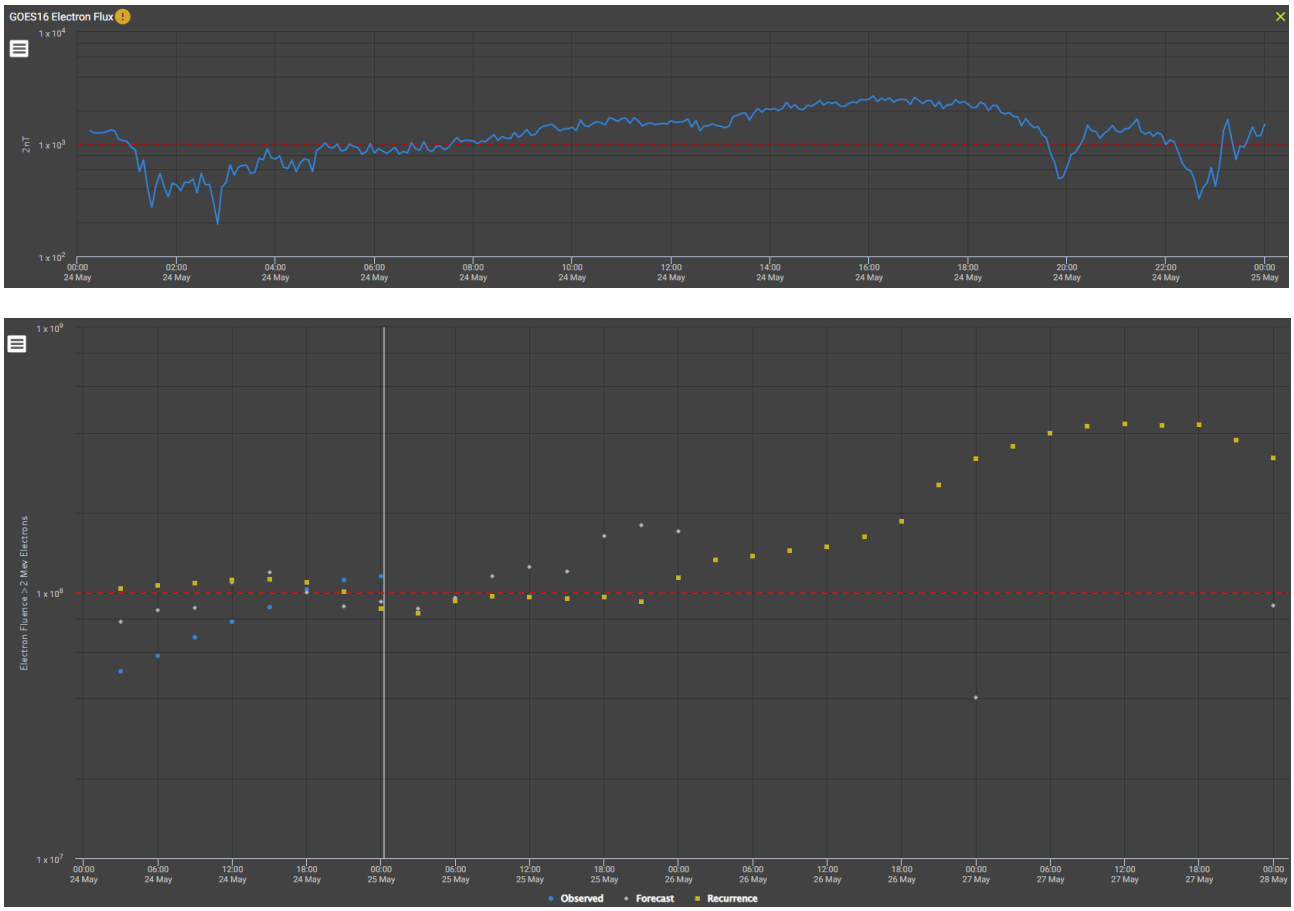
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as observed at GOES-16 is likely to continue to reach increasingly high diurnal peaks through the period due to the ongoing influence of the elevated high speed winds from coronal hole CH06/-.

Electron fluence is forecast to therefore follow a rising trend, with current values above the Active (1e8 integrated pfu) expected to remain so into the period, with current REFM model output viewed as good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	90	90	90	90
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 3: Latest 24hr GOES16 Electron Flux trace and MOSWOC REFM model.



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